

Soil Quality Improvements with Biochar and Compost

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BLACK CARBON (BC)

Black Carbon is a spectrum.











Photo Courtesy: Bruno Glaser, Jago Jonathan Birk, State of the scientific knowledge on properties and genesis of Anthropogenic Dark Earths in Central Amazonia (terra preta de Índio), *Geochimica et Cosmochimica Acta*, Volume 82, 2012, Pages 39-51.

Biochar



Academic (fancy) definition:

Pyrogenic Carbonaceous Materials



Biochar is (simply):

Carbon (C) rich material

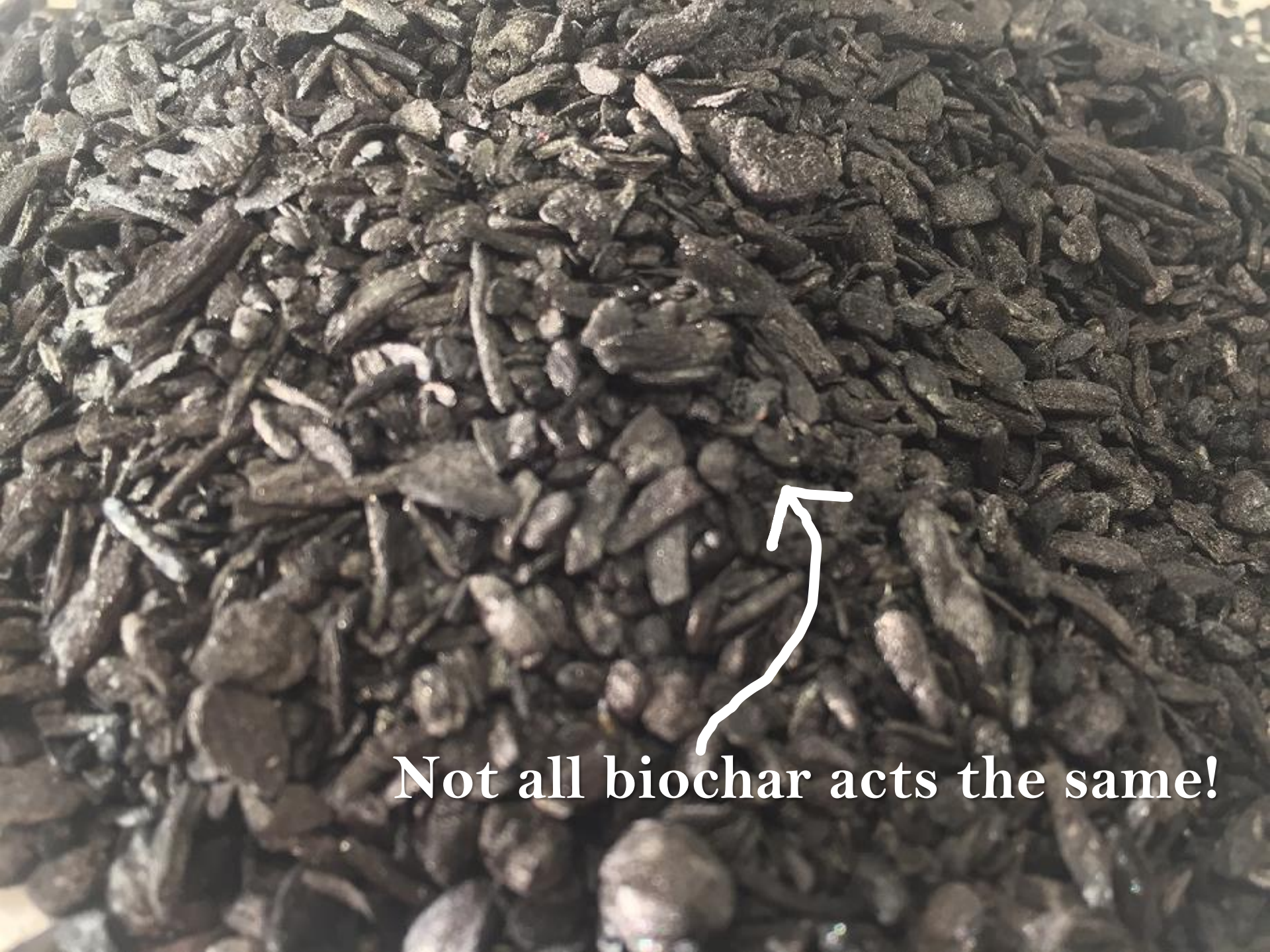
Made from biomass

Using high temps.

**In a low oxygen
environment**

(Pyrolysis)

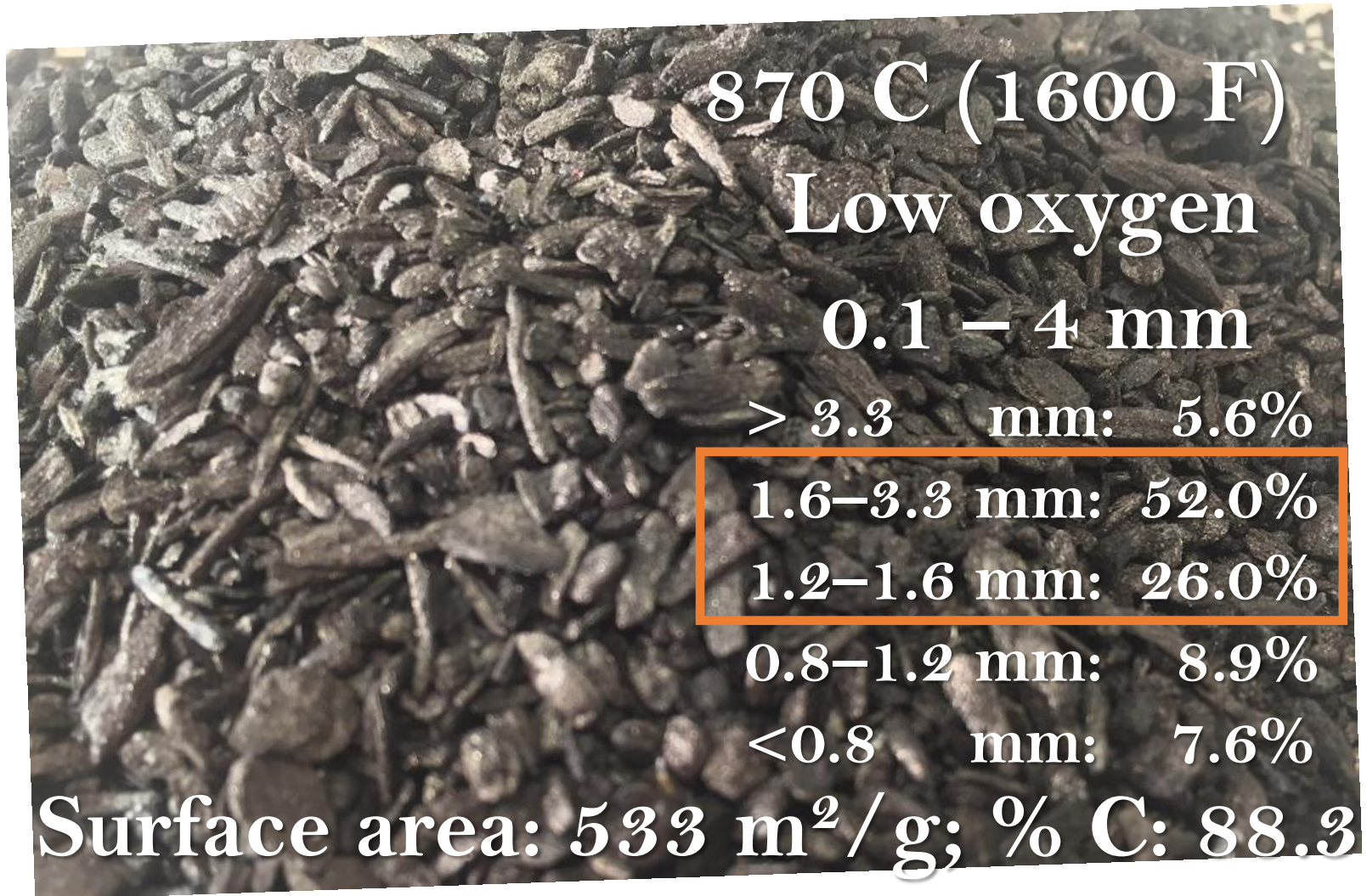




Not all biochar acts the same!



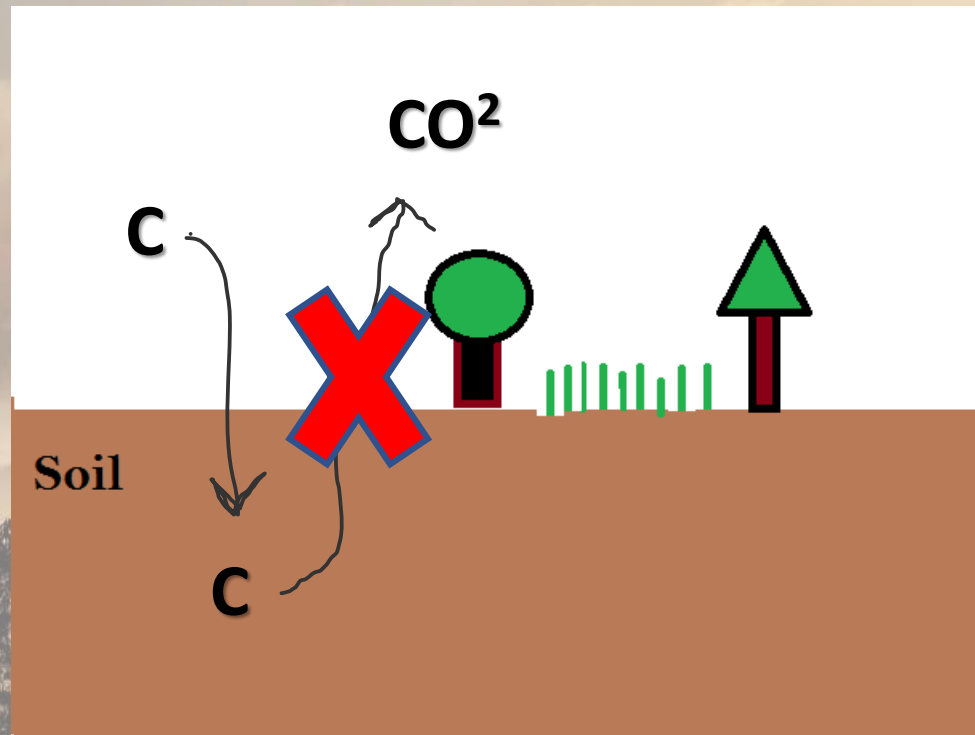
Oregon Biochar Solutions Rogue Biochar



Biochar does what to the soil?

Carbon Storage

Soil conditioner



Biochar does what to the soil?

Soil conditioner



Biochar can affect soil physical properties.

Increases aggregate
stability

Improves water
holding capacity

Can reduce
bulk density



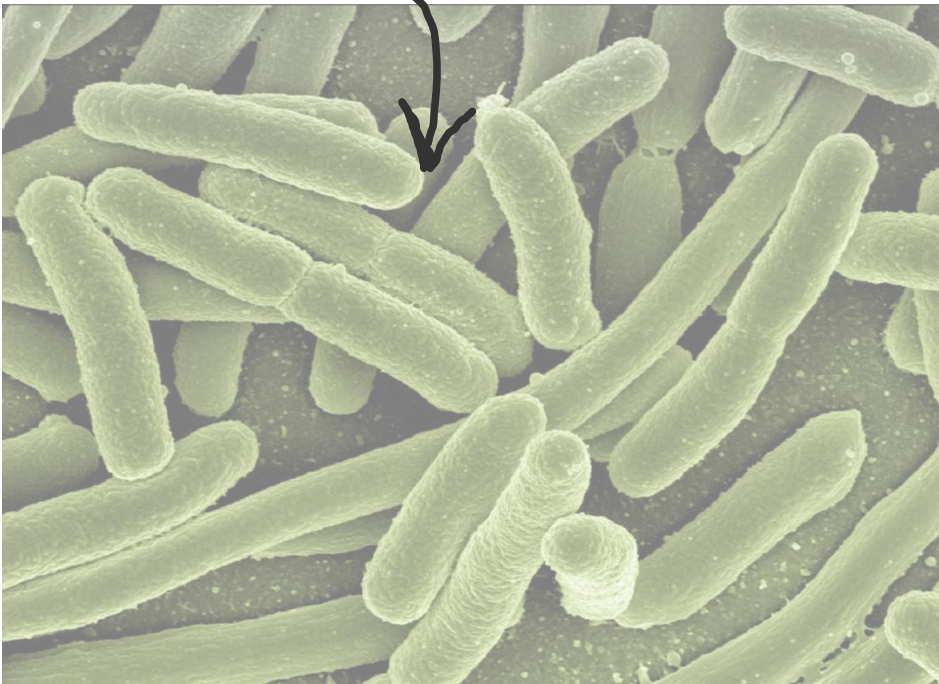
Biochar can affect soil chemical properties.

Reduces bio-availability of Pb, Cd, and As

**Influences cycling of plant nutrients
(details not quite clear)**

Biochar can affect soil biological properties.

Bacteria



Fungi





Biochar experiment.



ROGUE BIOCHAR™

Introducing **ROGUE BIOCHAR™**, our raw and non-inoculated carbon soil amendment. Recurring customers love our product for the following attributes:

- High **surface area** and **porosity**.
- High **carbon content**, a level that rivals some activated carbon products.
- **Low ash content** (less than 10%).
- **Uniform granulation** for easy handling.

A product of OREGON BIOCHAR SOLUTIONS, LLC

ABOUT THIS IMAGE: Vermorel soil blend (control) on the left and Rogue Biochar™ soil blend (test) on the right.

ROGUE BIOCHAR™ PRICE SHEET
Call **(541) 275-1160** to speak with a sales associate

Pricing does not include freight. Oregon Biochar Solutions can help arrange freight for our customers FOR White City, OR. Call to inquire about our exclusive low-cost delivery options in Jackson County, Oregon. Please visit www.chardirect.com/rogue for up-to-date pricing information and important notices about availability in your state.

<p>Loose Truckload Unit Cost: \$185 / cubic yard</p> <p>\$15,525 / 115 cubic-yard walking-bed trailer</p> <p>Skip the sacks and save! Delivered in a walking bed trailer, we offer the most competitive rate for truckload quantities of high-quality biochar. Rogue Biochar™ is extremely light and needs to be stored "loose" or in a covered bunker. Order by the loose truckload if you can safely store the material. OBS will share a fire safety data sheet in advance so that customers ensure their facility is ready for the product.</p> <p>BEST VALUE!</p> <p><small>IS A TRUCKLOAD NOT ENOUGH? Additional discounts are negotiable for multi-truckload orders or regularly recurring truckload orders. Visit chardirect.com/bulk to request a quote.</small></p>	<p>Bagged Truckload Unit Cost: \$149.99 / cubic yard</p> <p>\$14,999 / trailer or flatbed with 50 super sacks (larger load pictured above)</p> <p>For customers who do not have large-capacity on-site storage, your biochar will be protected from the elements, and you can rest easy that your investment will not lose efficacy — our raw product's shelf life is virtually unlimited.</p> <p>FLEXIBLE STORAGE</p>	<p>LTL Quantities Unit Cost: \$249.50 / cubic yard</p> <p>\$499 / 2 cubic-yard super sack</p> <p>Denominated in 2 cubic-yard super sacks, this option is perfect for product trials, feasibility studies, and boutique applications. Depending on humidity levels, each sack weighs approximately 325-375 lbs.</p> <p>PERFECT FOR GROW TRIALS</p>
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Biochar experiment treatments.

Biochar

Compost

Compost mixed with
biochar (as it composted)

Compost mixed with
biochar (at the time of
application)

Control



Amendment properties

Treatment	C %*	N %*	NO ₃ / NH ₄ ppm*	Ash %*	pH	BD lbs yd ⁻¹	% Moist
Biochar	88.3	0.78	na	3.7	8.0	460	3.1
Compost	32	2.2	31/ 270	38.1	8.5	891	52.1
Co- compost	32	2.2	130/ 95	38.9	8.3	891	52.7

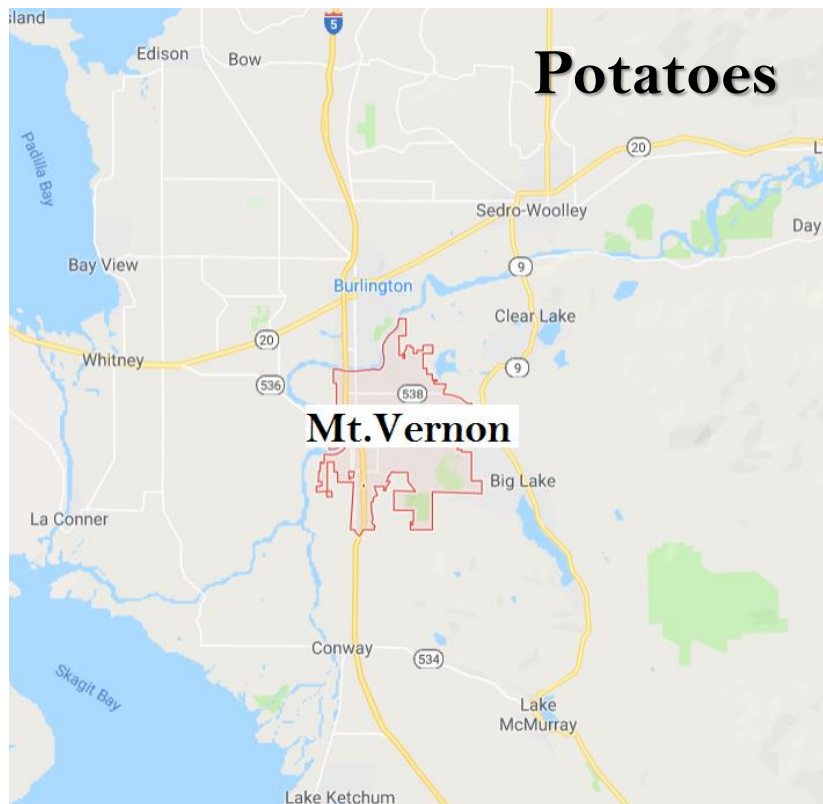
*Dry weight basis

Treatment rates.

Treatment	Rate (yds/acre)	Rate (dry tons/acre)
Biochar	21.30	4.5
Compost	29.05	12.2
Co-composted biochar	29.05	12.2
Compost + biochar	(14.35) + (10.19)	(6.025) + (1.4)
Control	0	0

Amendments applied at 3.9 tons organic C / acre

Biochar experiment.



Biochar experiment treatments.

REP 1	
Co-C 105	B 110
N 104	C/B 109
B 103	Co-C 108
C/B 102	C 107
C 101	N 106

Fertilized

Unfertilized

Biochar experiment response variables.



Data:

Yield

Bulk density

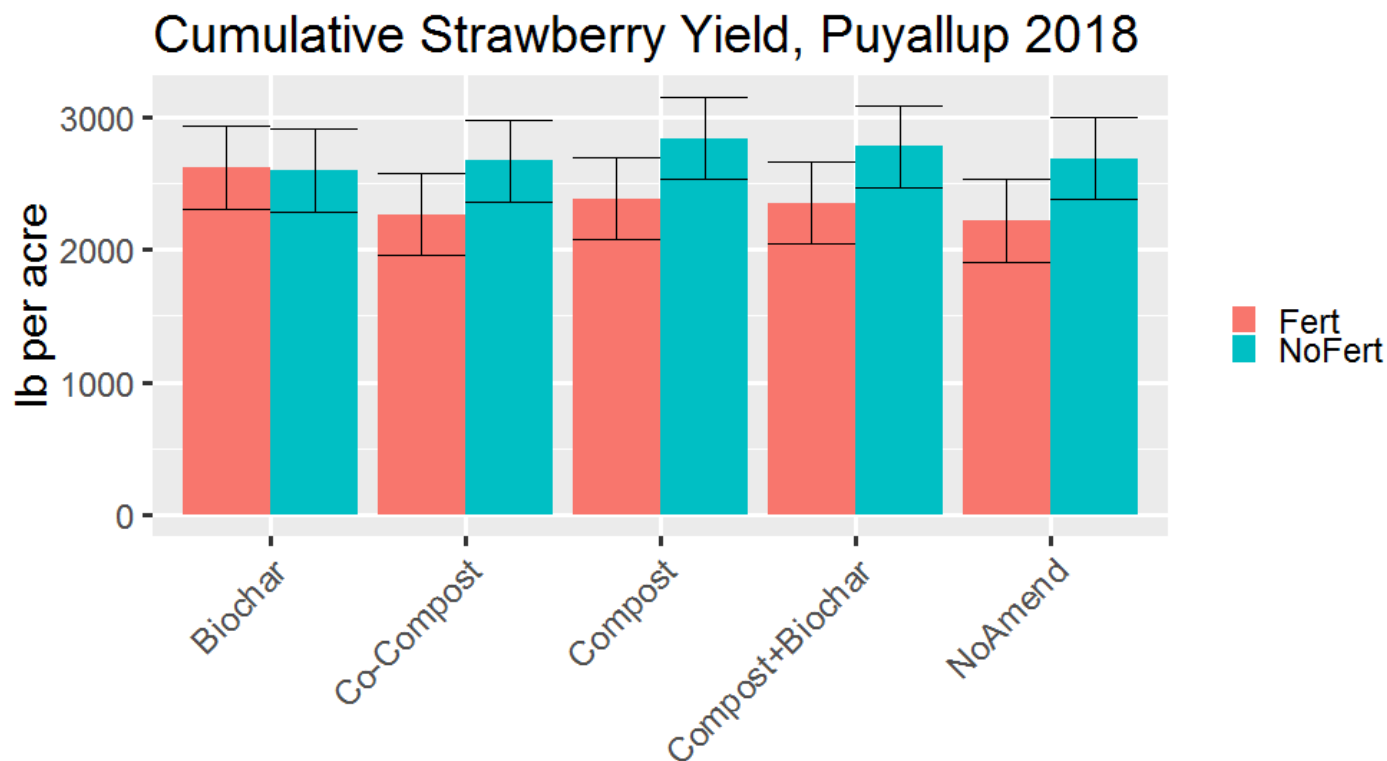
Water holding
capacity

Nutrient availability

POMC

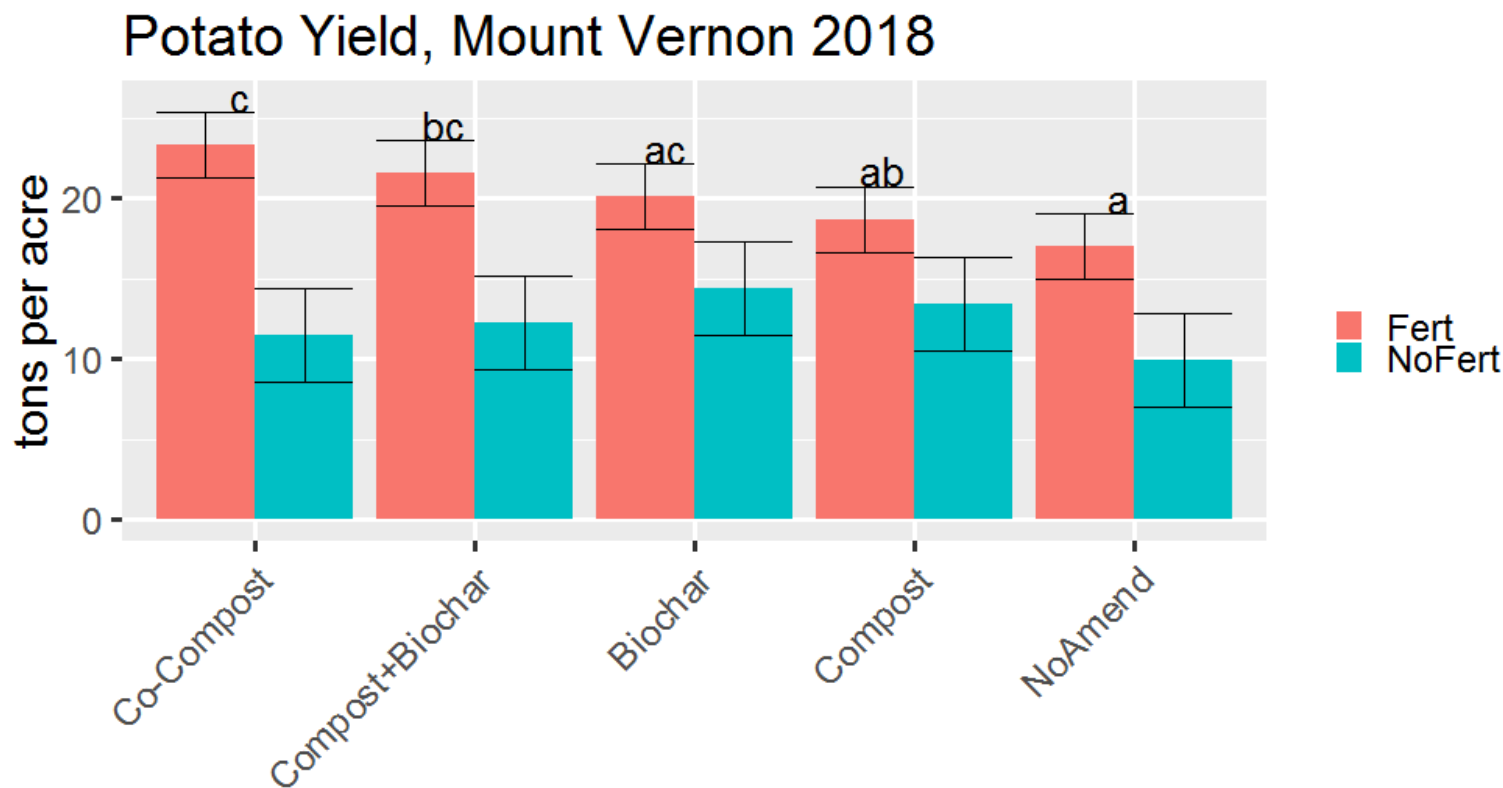


Biochar initial results.



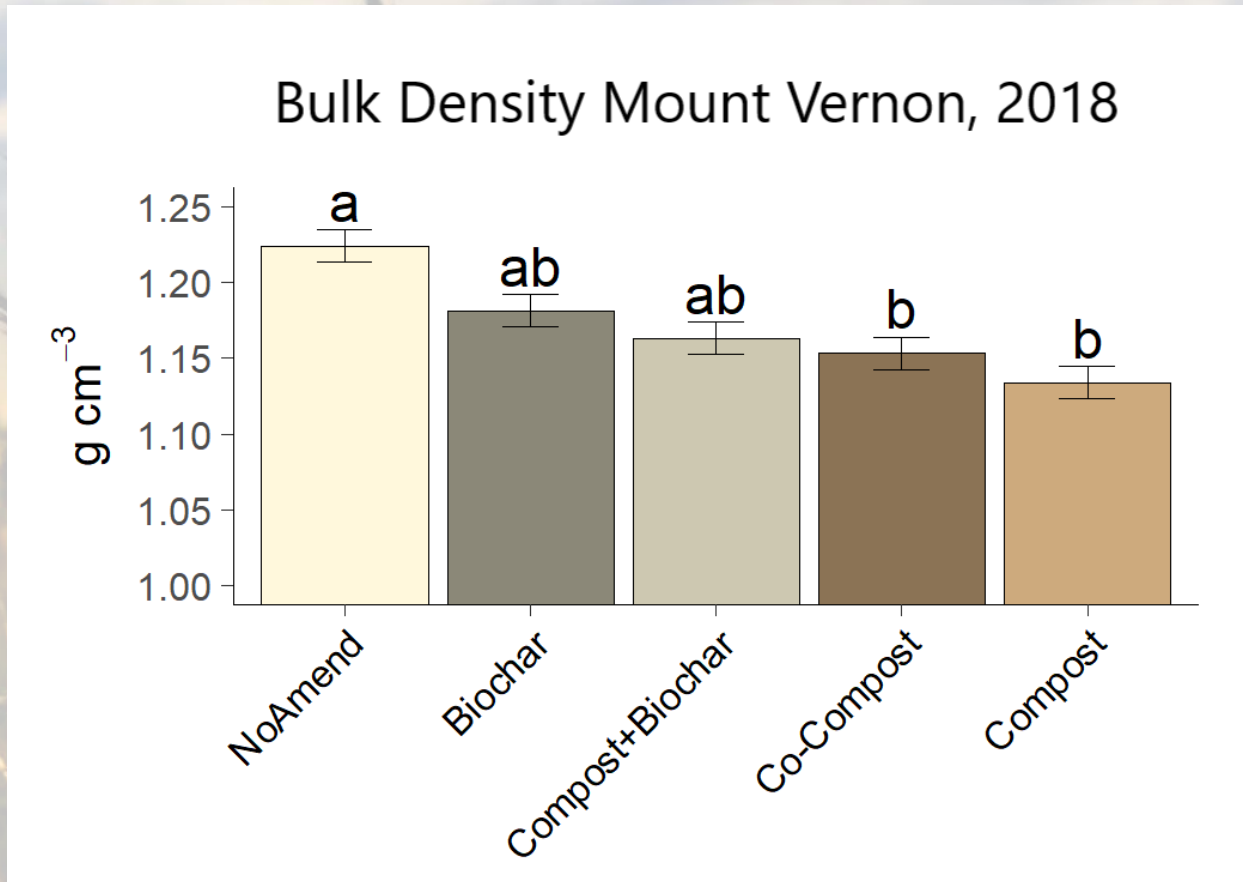
P Values: Fertilizer=0.11; Amendment=0.63
AmendmentXFertilizer=0.33

Biochar initial results.

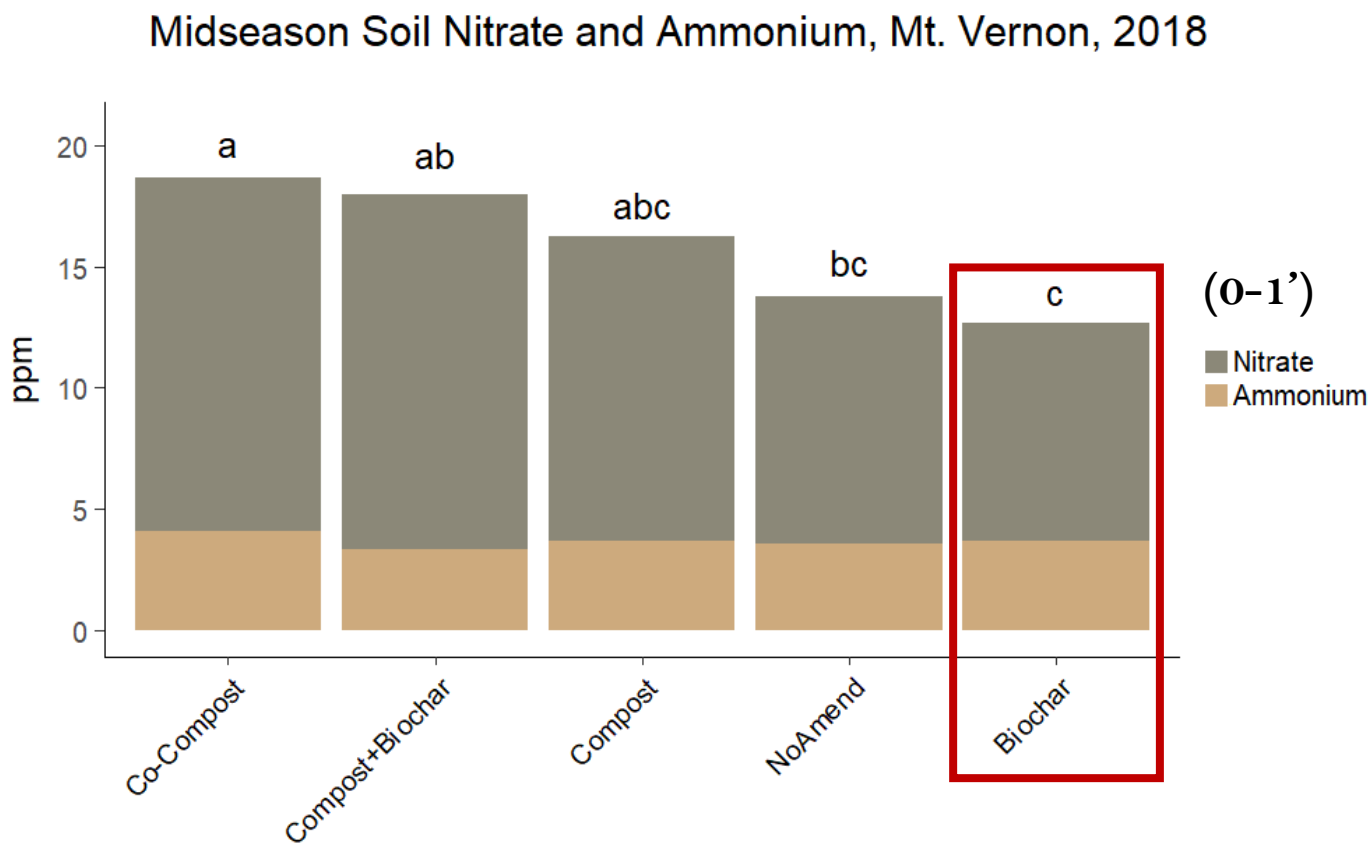


P Values: Fertilizer<0.001; AmendmentXFertilizer=0.01;
Amendment in fertilized plots<0.01;
Amendment in unfertilized plots=0.23

Biochar initial results.

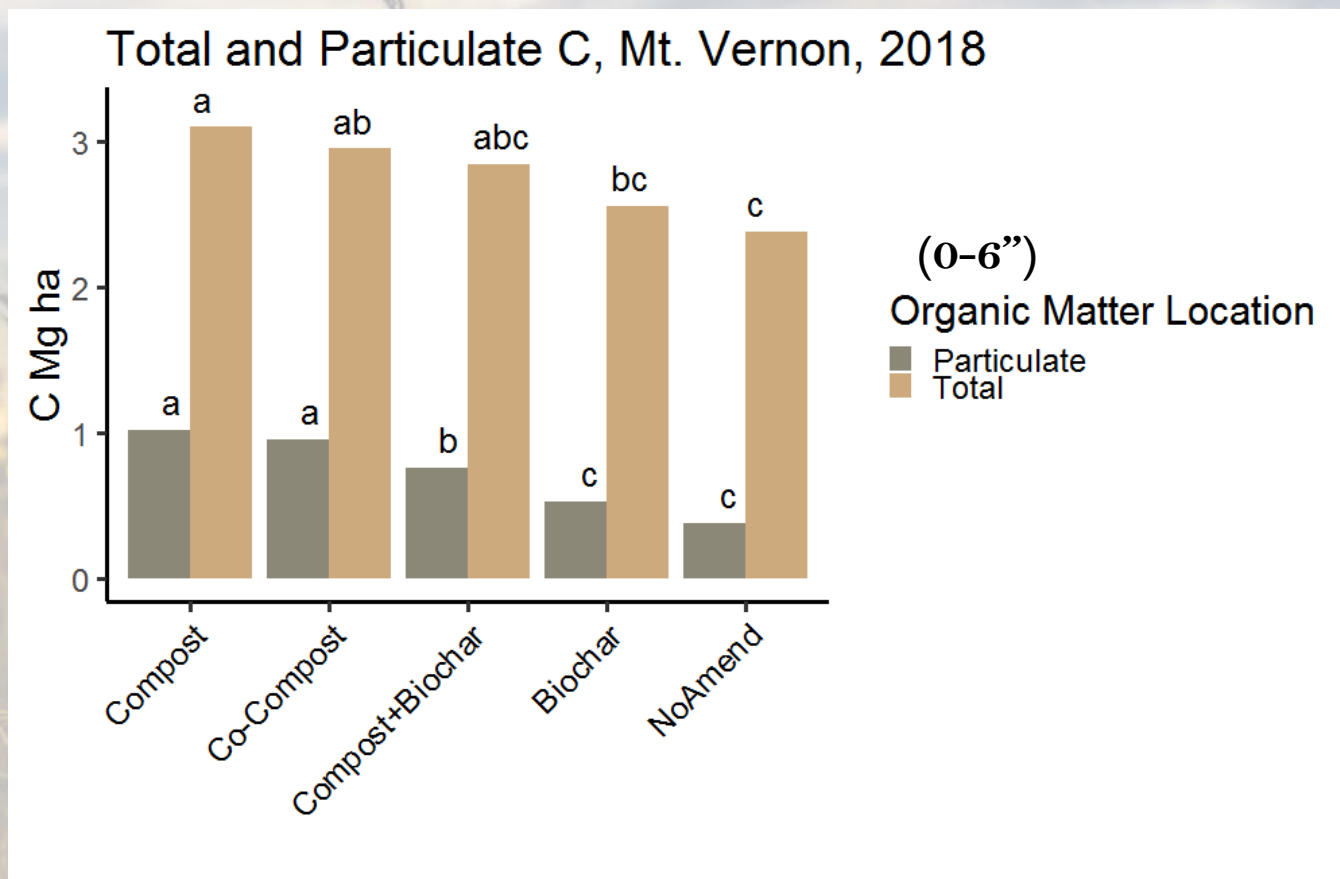


Biochar initial results.

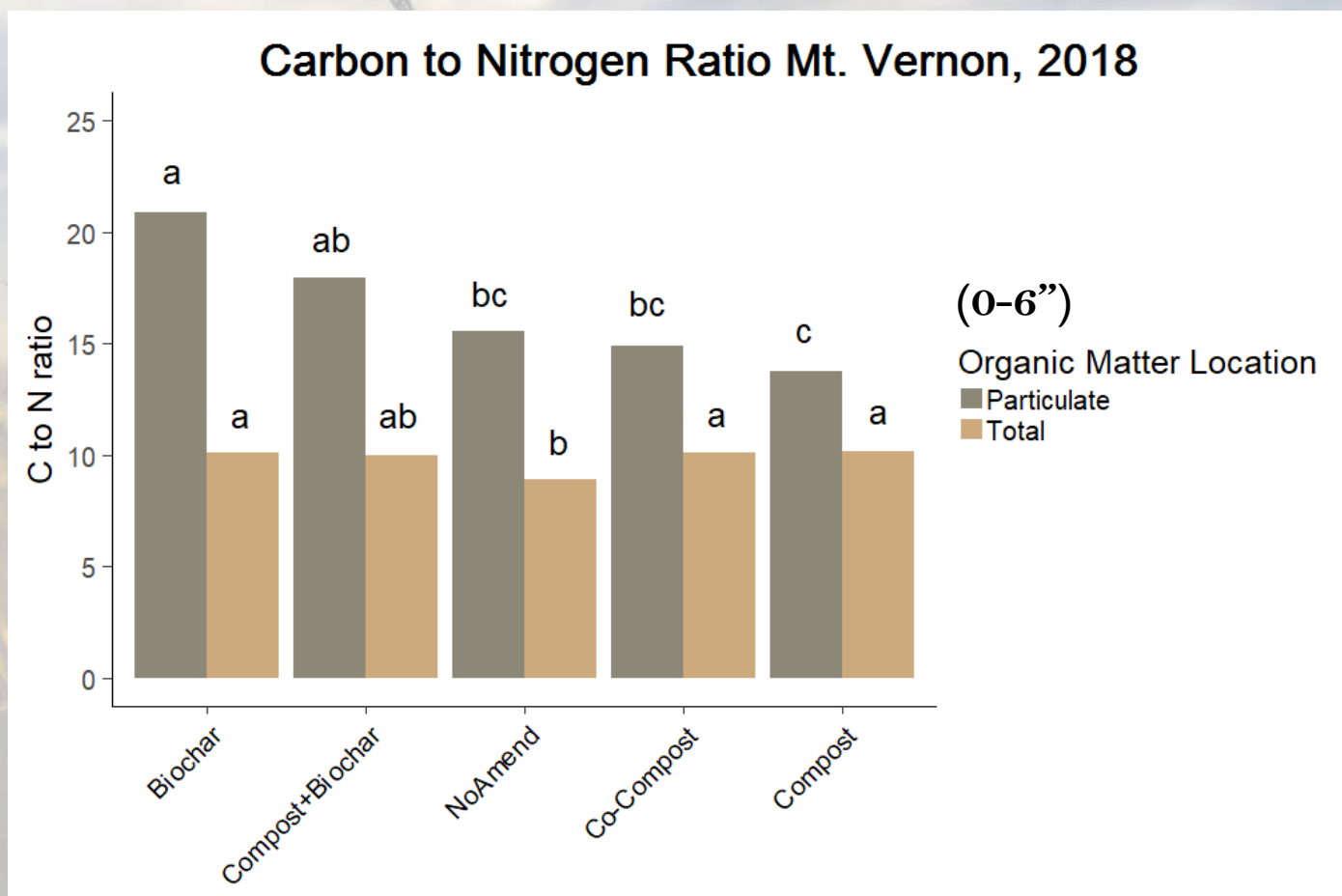


Unfertilized strips

Biochar initial results.



Biochar initial results.



Biochar takeaways.

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Thank you!

Questions?



References:

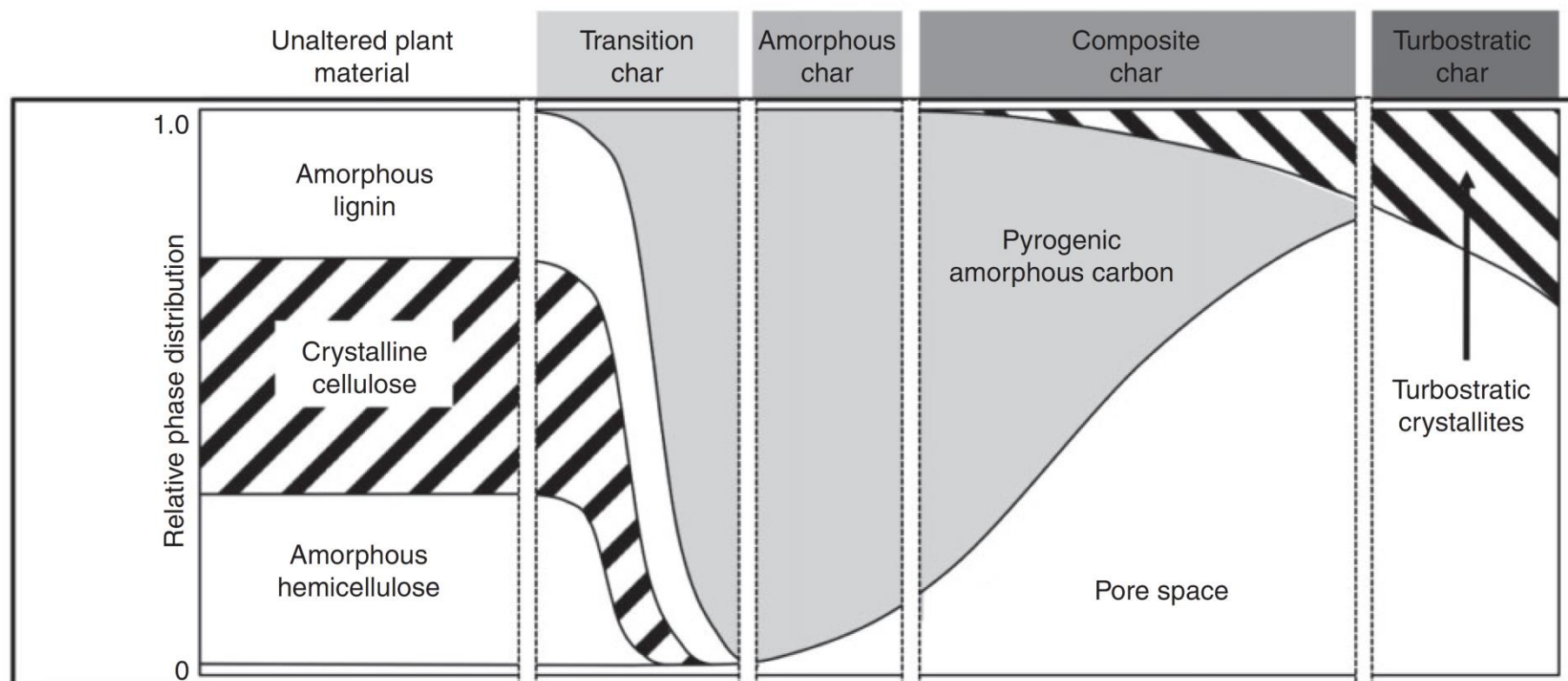
‘Activated Carbon, Biochar and Charcoal: Linkages and Synergies across Pyrogenic Carbon's ABCs’

‘Biochar: A Synthesis of Its Agronomic Impact beyond Carbon Sequestration’

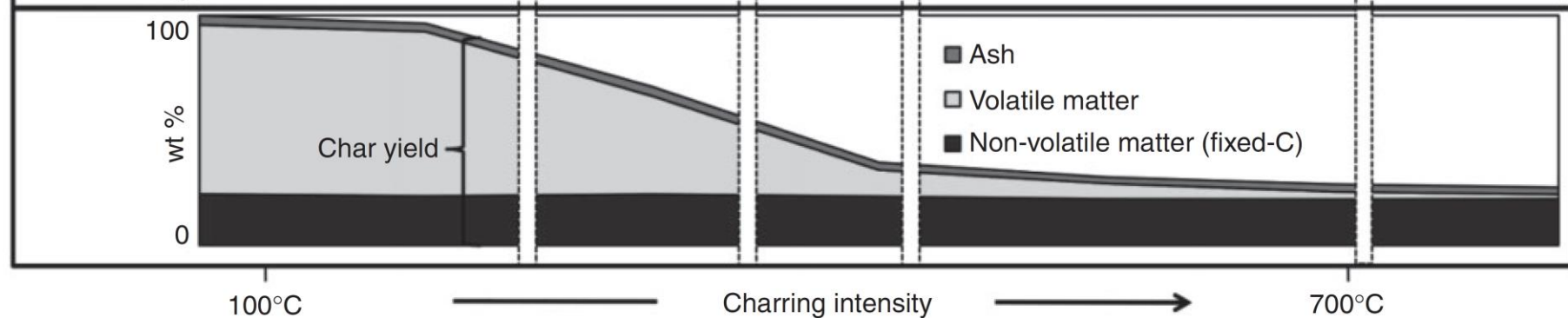
‘State of the scientific knowledge on properties and genesis of Anthropogenic Dark Earths in Central Amazonia (terra preta de Índio)’

‘Benefits and limitations of biochar amendment in agricultural soils: A review’

(a)



(b)



hydrogen 1 H 1.0079																	helium 2 He 4.0026																			
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180													
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948													
potassium 19 K 39.098	calcium 20 Ca 40.078																	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80								
rubidium 37 Rb 85.468	strontium 38 Sr 87.62																	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29								
caesium 55 Cs 132.91	barium 56 Ba 137.33																	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]								
francium 87 Fr [223]	radium 88 Ra [226]																	hassium 108 Hs [269]	meitnerium 109 Mt [268]	unbinilium 110 Uun [271]	ununilium 111 Uuu [272]	ununbium 112 Uub [277]														
																																				unquadium 114 Uuq [289]

6

C

Carbon

12.01017

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

* Lanthanide series

** Actinide series



What is Biochar?

A microscopic image showing numerous dark, irregularly shaped particles, likely black carbon, against a lighter background. The particles vary in size and shape, some appearing as small dots and others as larger, more complex structures.

Black Carbon (BC) and soil.

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